OUR-CEE
Overcoming Underperforming Renovations in Central and Eastern Europe

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Underperforming Renovations in the CEE Region: Challenges and Recommendations

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List of abbreviations

BPIE	Buildings Performance Institute Europe
BREEAM	Building Research Establishment Environmental Assessment Method
BRR	Building Renovation Roadmap
CEE	Central and Eastern Europe
EC	European Commission
EED	Energy Efficiency Directive
EFA	Environmental Fund Administration (Romania)
EFA	Environmental Fund Administration (Romania)
EIB	European Investment Bank
EMOR	Building Renovation Monitoring System (Hungary)
EPBD	Energy Performance of Buildings Directive
EPC	Energy Performance Certificate
EPEEF	Environmental Protection and Energy Efficiency Fund (Croatia)
ERDF	European Regional Development Fund
ESCO	Energy Service Company
ESIF	European Structural and Investment Funds
EU	European Union
GHG	Green House Gas
GUS	Central Statistical Office (Poland)
IEC	Information system of Energy Certificates (Croatia)
IPEEC	International Partnership for Energy Efficiency Cooperation
KAPE	Polish Energy Conservation Agency
LEED	Leadership in Energy and Environmental Design
LTRS	Long-Term Renovation Strategy
MDPWA	Ministry of Development, Public Works and Administration (Romania)
MEPS	Minimum Energy Performance Standards

Mtoe	millions of tonnes oil equivalent
NECP	Integrated Energy and Climate Plan
NEEAP	National Energy Efficiency Action Plan
NPCBSR	National Programme for the Consolidation of Buildings at Seismic Risk (Romania)
NRRP	National Recovery and Resilience Plan
NSI	National Statistical Institute
nZEB	Near Zero-Energy Buildings
OPECC	Operational Program Competitiveness and Cohesion
PEP	Polish Energy Policy
PJ	Petajoule
RES	Renewable Energy Sources
ROP	Regional Operational Programme (Romania)
RRP	Recovery and Resilience Plan
SEDA	Sustainable Energy Development Agency (Bulgaria)
SFM	Single Family Home
SIC	State Inspectorate in Construction
ZEB	Zero Emission Buildings

Executive summary

The Central and Eastern European (CEE) region faces significant challenges in meeting the building energy efficiency goals set by the European Union. Despite considerable efforts to renovate the region's building stock, deep energy savings remain limited, and renovation projects often underperform relative to expectations. With the built environment contributing nearly 40% of the EU's emissions, and the continued fossil fuel dependence of CEE countries, improving building energy efficiency through renovation is an essential action for reaching the EU's climate goals.

The Energy Performance of Buildings Directive (EPBD) establishes a framework for improving building energy performance, including standardised calculation methodologies, minimum renovation requirements, and Energy Performance Certificates. In alignment with the European Green Deal, the "Renovation Wave for Europe" aims to double the energy renovation rate by 2030, serving as a crucial step toward achieving the EU's decarbonisation targets by 2050. The most recent revision of the EPBD, adopted in 2024, increases the ambition of building-related energy efficiency improvements, with particularly ambitious standards and goals for public buildings.

Considering the EU's energy efficiency targets, CEE countries face unique challenges, including an ageing building stock, dependence on fossil fuels, and inadequate insulation standards. Decarbonisation efforts are inconsistent across the region, often dependent on government initiatives and varying levels of climate action, and renovation rates reflect a sluggish pace of climate action. In particular, a lack of monitoring of the actual impact of implemented renovations leads to potential delays in achieving renovation goals and an inefficient use of public funding, often used to finance building renovations. To overcome these issues, meet energy efficiency targets and transform its building stock, the CEE region must learn from past experiences and best practices while strengthening policy and implementation frameworks for building renovation. This report shows that many renovation efforts underperform due to common barriers such as poor monitoring and data availability, limited financing, inadequate regulation, and a lack of technical expertise.

The OUR-CEE project aims to shed light on the gap between planned and actual energy performance in renovated public buildings and recommends key strategies to mitigate underperformance. The main goal of this report, part of the OUR-CEE project, is to identify the primary barriers and underlying factors contributing to the low performance of building renovations across the CEE region. It provides an in-depth analysis of the status of the building stock in four CEE countries (Bulgaria, Croatia, Poland, and Romania), highlights common challenges, and offers recommendations to advance policy reforms, enhance financial instruments, and foster innovative solutions to accelerate sustainable and energy-efficient renovations. By implementing these strategies, the CEE region could make significant strides toward overcoming underperforming renovations, thus progressing against its climate goals, while maximising ancillary benefits such as socio-economic development and public health.

1. Introduction

Buildings are among the largest consumers of energy and emitters of greenhouse gases (GHG). They contribute significantly to global energy consumption and CO_2 emissions, being responsible for one-third of global energy use and a quarter of emissions. They are a focus of climate policies, due to their massive potential for energy efficiency improvement and renewable energy adoption. Europe's buildings sector is its single largest energy consumer, responsible for 36% of the EU's greenhouse gas emissions and 40% of its final energy consumption and is a strategic sector for European energy policy.

As a result, improving the energy performance of buildings is indispensable (European Commission, Directorate-General for Energy, 2019), reducing energy consumption and related emissions while protecting consumers and the environment. Alongside climate benefits, the deep renovation of buildings brings benefits such as indoor comfort, improved public health, increased adaptation of the built environment to climate change, and economic opportunities such as new jobs, if construction personnel are properly upskilled.

In Europe, nearly all of today's buildings will still be standing in 2050, therefore energy renovation is crucial for the transition towards net zero. Better energy performance is typically linked to new buildings, erected according to higher efficiency standards however, in most European countries, half of the housing stock was built before 1970. Most buildings constructed before the early 2000s, of which Europe has a significant share, have low levels of energy performance; 75% of buildings built before 1990 fall into lower energy classes (BPIE, 2017), which means they have a large potential for energy efficiency improvements and require significant upgrades to satisfy current energy efficiency standards. A decarbonised building stock by 2050 will need to mostly consist of Zero Emission Buildings (ZEB).

However, today's rates of renovation (0.4-1.2%, depending on the country) are too low to fully exploit this potential; only 3% of the EU's building stock had an energy rating of A in 2017 (BPIE, 2017). These renovation rates need to triple, on aggregate, for the building sector to achieve the high energy efficiency goals by 2050. Furthermore, 20-25% of the building stock in 2050 will be new builds; therefore, they must be highly efficient, meeting the criteria of ZEB, as defined in the latest EPBD revision.

The EU policy addresses energy efficiency in buildings primarily through the Energy Performance of Buildings Directive (EPBD), which came into force in 2002 as the first EU legal act on energy policy in buildings. It introduced an energy performance calculation methodology, minimum requirements for major renovations, and provisions for setting Energy Performance Certificate (EPC) schemes. EPBD emphasised the role of the public sector in each Member State in setting more ambitious targets for the buildings occupied by public authorities, in an attempt to launch the public building stock at the forefront of energy efficiency improvements.

The European Green Deal focuses on promoting energy efficiency in the EU's building stock, with the *Renovation Wave for Europe* strategy aiming to double the EU's annual energy renovation rate by 2030 (European Commission, 2020). As part of the EU's ambitious Fit-for-55 package, the legislative package operationalising the Green Deal, the 2021 recast of the directive reinforced those requirements and introduced new ones, such as cost-optimal methodology, Minimum Energy Performance Standards (MEPs), requirements for near-zero energy buildings (nZEB), technical

systems requirements, Energy Performance Certificates (EPCs), inspection schemes, and national financial measures. As of 2021, in most EU countries, all new buildings as well as major renovations must meet nZEB standards. The EPBD is supported by other pieces of EU legislation, such as the Eco-design Regulation, the Energy Labelling Regulation, and the Energy Efficiency Directive. Collectively, these legislative efforts aim to achieve zero-emission building stock in Europe by 2050. The EPBD does not prescribe a uniform approach, allowing Member States to tailor their policies according to their specific circumstances. However, at the national level, EU Member States are mandated to adopt long-term renovation strategies (NPRBs) an important role in designing energy-saving policies, which are implemented centrally, but also locally, highlighting the essential role of local authorities and municipalities in implementing renovation schemes. As owners of many public buildings, which are subject to tighter energy efficiency requirements in EU legislation, local and national authorities are thus the main recipients of funds for renovation.

To meet the 2050 decarbonisation target in the building sector and capitalise on the EU's ambitious "Renovation Wave", EU countries must ratchet up their ambitions, learn from their past experiences and implement best practices in renovation policy and implementation. It is crucial to ensure renovations lead to significant energy savings in the long term, minimising any gap between planned and achieved energy efficiency levels. This is particularly important in countries with relatively low administrative capacity to implement and monitor climate action measures, such as the deep renovation of buildings.

Central and Eastern Europe (CEE) faces several issues addressing underperforming renovations within its building stock, which have not reached the expected energy savings. The OUR-CEE project, which this report is part of, focuses on identifying and closing the gap between planned and achieved energy performance in CEE buildings with a strong focus on underperforming renovations. Numerous renovations are a result of outdated regulations, such as those that came in 2016 and had less stringent energy performance standards. The project aims to ensure that future renovations effectively reach their potential for energy savings and avoid similar underperformance.

The project focuses on four CEE countries: Bulgaria, Croatia, Poland, and Romania, exploring the specific factors which may contribute to "underperforming building renovations".

In this paper, we use the term "underperforming renovations" to refer to renovation efforts which do not achieve the full potential of energy savings. This shortfall is often the result of numerous and complex challenges that arise during the renovation process, including a lack of post-renovation monitoring, inconsistent regulatory frameworks, financial barriers, and difficulties in collecting detailed building energy data (M. González-Torres, 2022). These challenges collectively create a gap between expected and actual energy performance, which can be caused by a range of factors including behavioural factors, market failures, and cognitive limitations (Thonipara, et al., 2019) .

With the European context of building energy performance outlined, the following section provides background on the CEE building stock and its challenges for deep renovation, identifying specific difficulties and prospects for enhancing building energy performance in the countries covered by the OUR-CEE project, and other countries in the region.

2. Background

CEE countries face significant challenges in increasing building energy efficiency. The region's older, inefficient building stock and reliance on fossil fuels, particularly for heating, result in higher energy

use and carbon dioxide (CO_2) emissions compared to Western Europe. Although there has been gradual progress, with lower emissions due to EU policies and more integration of renewable energy, CEE renovation rates remain low, averaging around 1% every year. To reach the EU's climate goals, CEE nations must speed up renovation activities, increase financial support, and strengthen policy enforcement. However, public authorities in CEE frequently face problems such as low resources and inadequate capacity, which can impair their capacity to manage and execute renovations.

Overall, most CEE countries have a higher energy consumption of their building stock, compared to the EU average, except Romania and Bulgaria (**Table 1**). Per m^2, most CEE countries have higher primary energy consumption in residential and public buildings alike (above 200 kWh/m^2) than Western countries, such as Germany and Austria (below 200 kWh/m^2) (European Commission, 2020). In 2021, energy consumption slightly increased in Austria, Hungary and Croatia. The energy consumption statistics per dwelling reveal significant variations amongst countries in the CEE region, emphasising the importance of focused energy-saving initiatives. The data emphasises the importance of targeted renovation programmes, particularly in rapidly developing CEE countries with higher reliance on fossil fuels.

Table 1: Unit final consumption per dwelling scaled to EU average climate

Country	2021 kWh/dwelling
Austria	20,120
Bulgaria	10,700
Croatia	22,679
Czechia	18,841
Germany	16,747
Hungary	20,120
Poland	17,678
Romania	13,258
EU	15,584

Source: (Odyssee-Mure, 2021), Free Energy Indicators | ODYSSEE (odyssee-mure.eu)

Despite a significant reduction in coal and oil consumption in other sectors, the buildings sector in CEE has seen a slower decline in fossil fuel dependency, with a 35% reduction over the last decade (Brauers & Oei, 2020). The persistent use of natural gas for residential heating — where it is used for space heating, water heating, and cooking— highlights a critical challenge (Nijs , et al., 2021). The region's distinctive energy profile and historical reliance on fossil fuels complicate the transition to cleaner energy sources, emphasising the need for tailored policies and investments that address these specific challenges.

In CEE countries, a building boom had taken place between the late 1940s and the early 1990s during the Communist regime. In Bulgaria, Croatia, Poland and Romania, over 40% of the building stock was built during the communist period. Large housing estates (panel buildings) constitute a significant, almost emblematic, component of Eastern Europe's architectural stock. These large blocks of flats, constructed primarily with prefabricated sandwich panels, have become an emblem

of the Soviet era. They share similar qualities and issues, being the subject of energy policy debates. The 1970s and 1980s were the apex of industrialised construction technology, and this was the preferred construction approach. The technology was invented in Western Europe and was widely used in Denmark, England, France, and other countries before the Soviet Union obtained the rights to use it and developed its own systems (Csoknyai, et al., 2016).

Many of CEE countries' Communist-era buildings are energy inefficient due to outdated heating and cooling systems, poor insulation, low-quality construction materials, and insufficient maintenance. Compared to Western Europe, the CEE building stock often requires extensive transformations to keep up and satisfy the modern energy efficiency standards, because many of them were intended to be multi-family apartment structures. Moreover, the CEE building stock is defined by a large urban-rural discrepancy in the built environment: urban areas include a greater number of multi-family units, while rural areas are dominated by individual homes, which are usually less energy efficient.

As noted by Misik et al (2024), CEE countries continue to struggle with energy efficiency challenges. These have social implications as well: CEE countries have higher than average rates of energy poverty. To address rising energy costs, CEE controls have introduced price controls, energy bill assistance, and tax reductions. However, such interventions should be paired with energy efficiency improvements and decarbonisation of the heating systems. Energy crises and inflation may cause delays in energy efficiency investments, necessitating comprehensive packages of financial and technical initiatives from national and local governments, rather than just needs-based financial support (Rogulj, et al., 2023).

The above challenges are significant and recur in public buildings as much as they do in residential and commercial buildings. Addressing these recurring difficulties necessitates significant efforts to enhance energy efficiency. Potential solutions include upgrading heating and cooling systems, improving thermal and acoustic insulation, employing higher-quality building materials, and establishing frequent and effective maintenance programs. Investing in energy-efficient technologies, such as solar panels or smart building management systems, can also assist cut energy use and associated expenses.

However, implementing deep renovation is hampered by several regulatory and administrative barriers, most prominently the lack of capacity in public institutions to implement remedial measures for the inefficient building stock that they own. For many years, the regulatory framework for buildings in CEE countries was characterised by a lack of ambition for energy efficiency. In Bulgaria, even after energy classes were initially introduced in national legislation in 2009, energy class C was considered adequate for building refurbishments until the end of 2022. Local authorities, which play a crucial role in public building renovations, often face resource constraints and a lack of technical know-how about complex renovations, particularly for older, energy-inefficient buildings.

Perhaps most significantly, there is limited knowledge in CEE countries on how their renovation measures contribute to energy savings, and conversely, what is the prevalence of "underperforming renovation" (*see previous section*). Given the sluggish pace of renovation and the difficulties in accelerating deep renovation rates, a lack of knowledge of the ultimate impact of those renovations which are executed raises significant concern about how energy efficiency measures actually contribute to energy savings and the achievement of national energy efficiency targets. A lack of data and monitoring of post-renovation performance is a common challenge in all CEE countries,

strongly linked to the lack of institutional capacity and complexities of the renovation process, which requires skill and knowledge in the execution of refurbishment works.

The OUR-CEE project aims to support the roll-out of high-performing renovations on public buildings and provide a blueprint for remedying underperforming renovations already conducted. As part of the project's first work package, national project partners have elaborated national baseline assessments on the prevalence, risks, and solutions regarding underperforming renovations in their countries. These assessments aim to enhance institutional knowledge of underperforming energy renovations at national and local levels. They seek to identify the causes of underperformance in public building renovations and recommend policy measures to improve future renovation projects.

The following section presents country-level findings from partners' national reports on Bulgaria, Croatia, Poland, and Romania.

3. Country-level findings

This chapter is based on national reports of the OUR-CEE partner countries and can be found on the project's official website (Bulgaria[1], Croatia,[2] Poland[3] and Romania[4]). It summarises and synthesises the most important findings, providing a detailed review of the main points. The emphasis will be on explaining the key trends, patterns, and insights that arise from these reports.

3.1. Bulgaria

3.1.1. Building stock characteristics, related policies and legal framework

For Bulgaria, there are no public comprehensive statistics available to the public regarding the whole building stock. However, information about residential buildings can be found at the National Statistical Institute (NSI). The LTRS provides some information on non-residential buildings, but the primary source for data on building energy performance is the National Register of Building Energy.

The LTRS reveals that non-residential buildings have a total floor area of nearly 105 million m^2, the largest being hotels and restaurants. Most buildings are owned by the central government and local authorities, with a 29% share (30 million m^2) and 56.6% share by privately-owned buildings (meaning 59 million m^2). The public building stock in Bulgaria is about 61 million m^2.

For residential buildings, the NSI supplies the following fuel type information: almost half of occupied dwellings (47.7%) are heated with electricity, 36.3% with wood, 13.3% with central heating, 4.8% with coal, 4.1% with pellets and 2.5% with natural gas from a central source. The 2021 national energy balances provided by the NSI show that the household sector consumes 27,935 GWh, with electricity accounting for 42.8% and renewables and biofuels (mostly wood and pellets) accounting for 31.8%. Total energy consumption data for public buildings is unavailable. Most public buildings

[1]Kamen Simeonov, Center for Energy Efficiency EnEffect, 2024. National baseline assessment on underperfoming renovations Bulgaria.
[2] Regional Energy Agency North, 2024. National baseline assessment on underperforming renovations Croatia.
[3] Izabela Kuśnierz, Polish Network Energie Cités, 2024. National baseline assessment on underperforming renovations Poland.
[4] Energy Policy Group, 2024. National baseline assessment on underperforming renovations Romania.

have had energy audits, and SEDA's publicly available database provides detailed information on their energy performance.

The renovation targets for buildings are presented in a roadmap which covers three segments of time 2021-2030, 2031-2040 and 2041-2050. The LTRS presents targets for residential and non-residential buildings, but not public buildings. Non-residential buildings are set to renovate only 17% of their total area by 2050, despite public buildings being 29% of all non-residential buildings. The renovation process is driven by unpredictable market mechanisms. LTRS outlines a roadmap for building efficient renovation up to 2050, with intermediate targets until 2030 and 2040. The strategy assesses area and potential savings based on the energy sector balance.

The LTRS strategy to 2050 focuses on assessing the area of buildings to be renovated and potential savings from building renovation, with targets split for non-residential and residential constructions. A successful implementation could significantly improve the volume and quality of building renovation. Also, the LTRS strategy aims to enhance building renovation implementation by training stakeholders, including architects, engineers, and construction workers. It also explores existing financial sources and new ones, including creating the National Decarbonisation Fund to attract additional private sector. While the strategy is comprehensive and has the potential to significantly boost Bulgaria’s renovation rate, its success will depend on effective implementation, accessible financing, and strong public engagement. Without these elements, achieving the ambitious goals of the LTRS may be challenging.

The Bulgarian government presented a preliminary draft of the NECP (*Integrated Energy and Climate Plan of the Republic of Bulgaria 2020-2030)* to the Commission in February 2024, which was criticised for lacking energy consumption models and GHG emissions forecasts. The Commission made 22 recommendations, including robust financing for energy-efficient and decarbonised national building stock and measures to mobilise private investments to support energy and climate targets.

The National Recovery and Resilience Plan (NRRP) in Bulgaria, adopted in 2022 aims to reform and implement a National Decarbonisation Fund to support low-carbon investments. The fund will offer grants, technical assistance and financial instruments. The NRRP also proposes 100% grants for energy-efficient renovation of public buildings, requiring a 30% reduction in primary energy consumption. The European Investment Bank (EIB) and World Bank (WB) conducted a market analysis between 2022-2023, finding sufficient funds for public building renovations to meet the LTRS target. However, residential buildings face a significant shortfall in secured funds.

The policies outlined in Bulgaria's NRRP, along with the establishment of a National Decarbonisation Fund, mark a significant step toward enhancing energy efficiency. The fund will offer grants, technical assistance and financial instruments. The NRRP also proposes 100% grants for energy-efficient renovation of public buildings, requiring a 30% reduction in primary energy consumption. However, the market analysis by the European Investment Bank (EIB) and World Bank highlights a critical gap. While there are sufficient funds for public building renovations to meet the LTRS targets, there is a substantial shortfall in secured funds for residential buildings. In conclusion, although these policies provide a robust framework to improve Bulgaria’s renovation rate, their success hinges on addressing the financial shortfall in the residential sector, necessitating further policy adjustments and resource mobilisation.

The Energy Efficiency Act regulates building renovations, following the EED and the EPBD requirements, along with by-law regulations, where the main one is:

Ordinance No E-RD-04-2 of 16.12.2022 on energy efficiency audit, certification, and evaluation of energy savings of buildings which outlines procedures for conducting energy performance audits, issuing certificates, and preparing energy savings assessments for buildings, ensuring efficient energy use.

Ordinance RD-02-20-3 of 09.11.2022 on the technical requirements for the energy performance of buildings which mandates energy buildings performance, requiring all existing buildings to be at least energy class B. Starting in 2024, new buildings must meet the national definitions of nearly zero energy buildings. The ordinance also presents a methodology for calculating energy performance and scales for different building categories. The scales have been updated to include ratings from A to G, and a methodology is presented for determining building types without a specified scale.

3.1.2. Assessment of energy performance of related buildings

The LTRS analyses optimal costs for renovating the four main types of public buildings (administrative buildings, schools, childcare facilities and hospitals). It determines maximum, minimum and average energy consumption values, based on national regulations and presents average optimal cost levels.

The Sustainable Energy Development Agency (SEDA) manages the national registry of energy-audited buildings, which contains detailed information on 11,352 buildings as of March 25, 2024. The buildings cover 43.97 million m^2, with 8,736 non-residential buildings accounting for almost 25% of the overall non-residential area. The registry provides energy performance statistics, recommended energy-saving actions, and predicted reductions in energy, prices, and CO2 emissions.

For all four building categories, two types of analysis are performed: (a) comparing the expected energy performance against national benchmarks, and (b) comparing the average energy performance within a specific energy class to the estimated average performance of buildings that energy auditors recommend upgrading to that same class.

The SEDA register data reveals key insights into the energy performance of public buildings, particularly those recommended for renovation to achieve specific energy classes. School buildings, where 84.7% of audits suggest renovation, are a significant focus. The analysis compares the maximum energy performance of buildings in each class to current regulations and energy auditors' recommendations, alongside the cost-optimal national benchmark set by the LTRS for school buildings. Results show that, despite regulations, the average energy performance of these buildings is close to the maximum for each class. However, buildings recommended for class B renovations exceed the cost-optimal benchmark by 47.22 kWh/m², while those for class C exceed it by 84.51 kWh/m².

In a broader analysis of Bulgaria's public service, healthcare, school, and childcare facilities, the average energy performance following recommended measures also nears the maximum for each energy class. The average energy performance of childcare facilities meets the maximum allowed under previous regulations. Yet, public service buildings, on average, fall short of the cost-optimal renovation benchmark, with class B and class C buildings exceeding it by 89.65 kWh/m² and 124.02 kWh/m², respectively.

The analysis of administrative buildings, covering 68.8% of those registered, reveals that energy performance after recommended measures still exceeds the cost-optimal benchmark (140.31 kWh/m²) set by the LTRS. Specifically, buildings recommended for energy class B exceed the benchmark by 89.65 kWh/m² (over 63%), and those for class C exceed it by 124.02 kWh/m² (over 88%).

In healthcare buildings, 80.9% are recommended for class B or C. Here, the energy performance also surpasses the benchmark (166.98 kWh/m²), with class B buildings exceeding it by 51.55 kWh/m² (over 30%) and class C by 103.83 kWh/m² (over 62%). The smaller excess in healthcare buildings is due to the combined evaluation of hospitals and smaller facilities, as well as the inclusion of non-system-related energy consumption.

Energy auditors often recommend renovations that meet only the minimum energy performance requirements, driven by municipalities seeking funding through grant schemes. However, these recommendations frequently fall short of the cost-optimal renovation benchmark, leading to missed opportunities for energy savings and impeding progress toward climate neutrality in public buildings. The key issue is the quality of implementation, which often results in buildings not achieving the expected energy performance post-renovation.

3.2. Croatia

3.2.1. Building stock characteristics, related policies and legal framework

Croatia is committed to reducing GHG emissions and enhancing energy renovations. However, the country's energy renovation efforts began in 2012, with only 1% of residential sector renovations being medium depth and 0.1% deep.

The building stock in Croatia covers a total gross floor area of 198 million m^2 in 2011. In 2020, Croatia's building stock reached 237 million m^2, with 179 million m^2 in residential buildings and 59 million m^2 in non-residential buildings.

Despite initial challenges, renovation programs have now targeted at least 50% energy savings for most projects. The current energy renovation rate is expected to rise to 3% over the 2021-2030 period, with a 10-year average rate of 1.6%. Energy and climate-related legislation is aligned with the EU acquis, with implementation falling within the competence of two ministries.

Building renovation is slow, because of a lack of policies directing investment towards renovation and preservation of existing stock. The registered energy renovation rate of Croatia's building stock was 0.7% between 2014 and 2020. The useful floor area for residential and non-residential buildings is expected to be 110 million m² by 2050. The Ministry of Physical Planning, Construction, and State Assets reported that 145 nearly Zero Energy Buildings were built between 2014 and 2019, but 616 buildings meeting nZEB requirements were not certified before 2019 compliance. The public sector is suffering delayed energy renovation, with many non-residential buildings still unrenovated.

Hospital buildings are the primary focus of energy renovation, accounting for 62% of the total renovated useful area. Educational buildings, which account for 58% of the renovated useful area, are also a significant contributor to this trend, as they are often targeted for national subsidies.

Energy consumption and energy performance of buildings are determined using certificates from the Information system of Energy Certificates (IEC). Multi-apartment and office buildings have evenly

distributed energy ratings, while other building types show a shift towards lower and higher ratings. Energy ratings reveal a significant discrepancy in building performance, particularly between hotels, restaurants, and office buildings in terms of thermal energy required for heating and their primary energy rating.

Regarding regulatory framework, Croatia's energy efficiency is regulated by various laws and by-laws, including the Energy Efficiency Act, Building Act, and Act on Protection against Light Pollution. These laws and regulations meet the requirements of EU directives such as Directive 2012/27/EU, Directive 2018/2002, Directive 2010/31/EU, Directive 2018/844, Directive 2010/30/EU, and Directive 2009/125/EC. They also comply with Directives on energy labelling, standard product information, and eco-design requirements for energy-related products. The country's energy efficiency measures are based on the EU's directives and relevant by-laws.

3.2.2. Assessment of energy performance of related buildings

The OUR-CEE national study on Croatia uses publicly available documents and the Croatian ISGE[5] information system to analyse renovation performance at the country level.

The Croatian Government adopted the Program for energy renovation of public sector buildings for 2014-2015 to meet the EED requirements and The National Energy Efficiency Action Plan (NEEAP) which outlines measures to improve energy efficiency across the entire territory of the Republic of Croatia under the NECP. It defines alternative policy measures to ensure the annual renovation of 3% of the total floor area of heated and/or cooled buildings owned and used by the central government. The programme sought to modernise at least 3% of the total floor space of government-owned buildings each year, leading to a 30-60% decrease in energy consumption and 20,500 tons of carbon dioxide emissions. The program was based on the energy service model, allowing for the implementation of energy efficiency improvement measures without additional budget funds.

The results show that 69 buildings have been renovated at 12 locations in 2014-2015, with an average savings of 51.69% in direct energy consumption and financial savings of over 4 million EUR/year. The share of renewable energy sources (RES) in the supply of renovated buildings is almost 20% of the building's total energy requirement.

However, the programme faced challenges due to the lengthy process of preparing project tasks for public procurement, the lack of data on the building's existing state, and the perception of high riskiness of ESCO (Energy Service Company) projects by financial institutions. The programme foresaw continued renovation using grants from the European Regional Development Fund (ERDF) and the Operational Programme "Competitiveness and Cohesion 2014-2020" (OPCC). Over EUR 253,4 million was allocated for projects under four calls, with EUR 53 million allocated to a lending programme managed by the Croatian Bank for Reconstruction and Development.

Financial institutions' perception of high risk in ESCO projects, as well as the lack of insurance for the ESCO company's own capital, are significant impediments to implementing this model. The European Structural and Investment Funds (ESIF) were used to support the renovation programme.

[5] ISGE is a computer application that monitors and analyses energy consumption in public sector buildings in Croatia.

The Fund for Environmental Protection and Energy Efficiency, along with the Ministry of Physical Planning, Construction, and State Assets, issued public grant requests to fund the projects.

The National Energy Efficiency Action Plan projected cumulative savings of 2.7700 PJ in 2020, with 93% of this goal achieved. Many of these savings come from projects using the ESCO model, 30% from the Operational Programme "Competitiveness and Cohesion 2014-2020" (OPCC-) co-financed projects, and 34% from the Environmental Protection and Energy Efficiency Fund (EPEEF). The ESCO model and EPEEF-co-financed projects have been implemented earlier, resulting in greater cumulative effects. The most significant annual savings are from projects co-financed by OPCC, followed by ESCO projects, and the Fund for Environmental Protection and Energy Efficiency. However, most public sector buildings have not been renovated, and those partially renovated do not meet the EED's minimum energy performance requirements. Legal amendments during the programme period 2014-2020 allowed projects to meet the maximum permitted values, limiting the building's potential for energy savings.

It can be concluded that the assessment of energy performance for renovated public buildings in Croatia reveals significant gaps in achieving optimal energy efficiency. Many renovations have been partial, with very few instances of deep-energy renovations. Consequently, most public buildings are either not renovated at all or fail to meet the minimal energy performance standards. These partial renovations have not realised the full potential for energy savings, leading to underperforming buildings that fail to contribute effectively to Croatia's energy efficiency goals. This underscores the need for more comprehensive renovation strategies that align with national standards and maximise energy savings.

3.3. Poland

3.3.1. Building stock characteristics, related policies and legal framework

Polish regulations emphasise the importance of building efficiency, requiring energy certification for newly constructed buildings and minimum energy efficiency standards for renovated public buildings. These regulations are backed by financial support programmes, such as grants and preferential loans, to support investments in building efficiency.

Poland, with 14.2 million buildings, has a significant proportion of buildings with low energy efficiency, requiring thermal efficiency improvements in the coming years. Most of these buildings were built decades ago, with low energy prices and inadequate thermal insulation. As of 31 December 2020, Poland had legislation aiming for nZEB for all buildings. The primary energy ratio for new residential buildings in Poland is 70 kWh/m^2 year, which is higher than the European Commission's 50-70 kWh/m^2 year range for a continental climate. However, Poland's requirements for non-residential buildings are 45 kWh/m^2 year, lower than the EC's 85-100 kWh/m^2 year range. The New Building Act does not specify renewable energy requirements, making Poland one of the worst performing EU countries in this regard.

In Poland, residential buildings make up 43% of the total building stock, while non-residential buildings make up 57%. Single-family detached houses and multi-family buildings make up 88% of the housing stock, while office buildings make up 26%. In 2019, residential buildings covered 1.1 million m^2, while non-residential buildings occupied 464,000 m^2.

Poland's buildings are predominantly energy inefficient, with over 70% having a primary energy ratio exceeding 150 kWh/m^2 per year, primarily in old, unmodernised detached houses and hospitals. Energy-efficient construction has only recently developed in Poland, with buildings with a primary energy ratio below 50 kWh/m^2 per year, accounting for only a small percentage of the total stock.

Buildings built before 1994 have the worst energy standard, with a primary energy ratio of over 150 kWh/m^2 per year. A strategy estimates 7.5 million thermal efficiency improvements by 2050, with 4.7 million deep improvements. The goal is for 65% of buildings to achieve a primary energy ratio of 50 kWh/m^2 per year by 2050.

According to the Polish LTRS, around 45% of public buildings were thermally upgraded by 2019. By 2025, the percentage of buildings with improved thermal efficiency is expected to reach 55-60%, including ongoing and planned projects by public institutions.

The Polish Energy Policy until 2040 (PEP2040) is a strategic framework for Poland's energy transition, focusing on the implementation of the Paris Agreement and Responsible Development. It aligns with EU regulations, aiming for a fair and solidarity-based transition. The policy emphasises renovating buildings, modernising heating systems, promoting high-efficiency cogeneration, and using renewable energy sources for heating.

The Polish government is implementing a national policy to improve energy efficiency, aligning with the EU's five dimensions: internal energy market, decarbonisation, research, innovation, and competitiveness. The policy includes measures for public organisations to enhance energy efficiency, including energy audits every four years. The EU directives, including Directive (EU) 2018/2002 and Directive 2012/27/EU on energy efficiency, are integrated into Polish law, aiming for a 20% increase in energy efficiency across the EU by 2020. The 2020 amendment also aims for a 7% reduction in greenhouse gas emissions and a 21-23% share of renewable energy sources in gross final energy consumption.

The NECP, adopted by the European Affairs Committee in 2019, is part of Poland's strategic framework for the country's long-term energy transition, ensuring a sustainable and efficient energy system. The Polish LTRS outlines three scenarios for thermal efficiency improvements in building stock until 2050, aiming to improve energy efficiency and low-carbon building stock. By 2050, 66% of buildings will achieve passive standards, 21% will reach energy-saving standards, and 13% will achieve efficiency levels. The average annual renovation rate is 4%, with deep thermal upgrades not exceeding 3% by 2035.

The Regulation of the Ministry of Infrastructure requires new buildings to meet energy performance requirements, to achieve 55-60% thermal efficiency by 2025. The LTRS also highlights the importance of supporting thermal efficiency improvements in public buildings, with a target of 3% improvement per year. The Regulation also mandates that all new buildings constructed after 31 December 2020 will be nearly zero-energy and for buildings occupied by public authorities after 31 December 2018.

3.3.2. Assessment of energy performance of related buildings

The Energy Performance of Buildings Act in Poland is a crucial tool for assessing the energy performance of buildings, including renovated public ones. The revised EPBD requires a uniform scale of energy performance classes, with class A representing zero-emission buildings and class G covering the worst-performing 15%. The Polish Energy Conservation Agency (KAPE) has proposed

a new scale of energy performance classes for residential buildings in 2023, which could be extended to public buildings. This approach aims to drive continuous improvements in energy efficiency and contribute to climate neutrality by 2050. The revised EPBD and KAPE's efforts aim to enhance energy efficiency, reduce operational costs, and contribute to environmental sustainability.

The Association of Energy Certifiers and Auditors has raised concerns about the accuracy of a central registry in Poland, which collects information on the energy performance of buildings. The registry is overseen by the Minister of Development and Technology, responsible for spatial planning and housing. However, the database contains errors and inaccuracies, which are not accessible to building owners, managers, state institutions, or energy consultants.

The effectiveness of Poland's renovation policies is limited by significant data collection issues. The registry, while intended to be comprehensive, it contains numerous errors, inaccuracies, and incomplete data. This lack of accurate information makes it impossible to estimate the true performance of renovated buildings, restricting policymakers' capacity to make properly informed choices and prioritise repairs that would result in the largest energy savings. The data's inaccessibility hinders public openness and accountability, hindering efforts to track progress towards national energy efficiency goals.

A 2019 Central Statistical Office (GUS) study revealed that 60.7% of multi-family residential buildings do not need improvements, while 39.3% need them to meet energy standards, as part of the Polish Long-Term Renovation Strategy.

The conclusions of the Polish LTRS highlight the issues created by insufficient data. While 60.7% of multi-family residential buildings do not require additional thermal efficiency improvements, the remaining 39.3% — nearly two out of every five buildings—do require renovations to satisfy current energy standards. This huge number of buildings in need of refurbishment demonstrates a significant promise for energy savings that is now untapped. Without precise data, it is difficult to decide which buildings should be prioritised or how successful previous renovations were.

The LTRS reveals that deep energy renovations as more cost-effective than shallow ones, particularly in older public buildings like schools and hospitals. These renovations not only save energy but also improve indoor air quality, temperature stability, and health. Despite these insights, the limits of available data prevent a complete assessment of renovation performance in Poland. The lack of access to thorough, accurate information limits a more in-depth knowledge of how large-scale renovations affect energy efficiency. It also raises issues about whether the buildings that require the most rehabilitation are appropriately identified and whether the renovations that are being carried out are fully effective.

In conclusion, while Poland has a structured policy framework and some valuable insights from the LTRS, the data limitations pose a significant barrier to fully understanding and optimising the impact of building renovations. Addressing these data challenges is critical for improving the energy performance of Poland's building portfolio and ensuring that repair activities are both successful and strategic.

3.4. Romania

3.4.1. Building stock characteristics, related policies and legal framework

In Romania, the national database lacks a comprehensive, up-to-date overview of the building stock by energy performance, including essential information like construction materials, occupancy rates, energy consumption, renovation status, and nZEB share. The principal sources of information have been retrieved from LTRS, BSO (Building Stock Observatory), Eurostat and the National Institute of Statistics.

The LTRS estimates that there are 5.6 million buildings in Romania. Of those, 5.3 million are residential buildings with a total gross area of 582.27 million m^2, and 242,500 are public and commercial buildings with a total gross area of 62 million m^2.

Residential buildings represent 90% of the building stock, with Single Family Houses (SFM) being the most common. The public building sector consists of 9.62% of the total building stock, including commercial (4.17%), education and healthcare (4.15%), and offices (with the lowest percentage).

Nearly 9,000 public buildings in Romania are owned by both local and national governments; most of these buildings serve purposes such as healthcare and education. The central government owns 3,087 buildings, while the local administration manages approximately 80,000.

Buildings contribute 42% of Romania's total final energy consumption, accounting for 40% of gas, 50% of electricity, and 74% of district heating demand. Residential buildings account for 81% of this, while public and commercial buildings account for 19%. The COVID-19 pandemic significantly increased residential energy consumption due to remote work, while public and commercial buildings experienced a decrease.

Romania's public buildings exhibit significant variations in energy consumption and thermal performance across different building types. Offices have the lowest energy consumption, while healthcare and educational buildings have the highest, ranging from 200-400 kWh/square meters per year for education and cultural activities

Romania's nZEB development strategy is one of the most unambitious among Member States, with 13% of buildings registered as such. However, there are numerous green buildings certified under voluntary schemes like BREEAM, LEED or Passive House. In 2022, BREAM or LEED reached 154 buildings, ranking the third in CEE area. By 2024, 24 buildings received the Passive House certification.

Usually, public buildings primarily use natural gas and electricity, with renewable energy sources and biofuels increasing since 2018. Since 2021, Romanian authorities have focused on diversifying energy systems, increasing solar energy use and installing photovoltaic panel systems. Public acquisition contracts for alternative sources increased by 4.5 in 2021 and 8 times in 2022, with various public institutions showing interest.

The Romanian LTRS outlines specific actions for public buildings to lead energy renovation activities. The Strategy seeks to renovate 8.25 million m^2 (26% of public buildings) by 2030, reducing CO_2 emissions by 0.25 million tonnes between 2021 and 2030. The highest renovation rate was in educational buildings (15% by 2020), with no data available for cultural and sports buildings. This includes public buildings owned and used by the government, as well as those rented or leased by

municipal or regional governments. It also includes buildings owned but not used by these administrations.

The NECP and the LTRS are the key strategic documents in Romania, providing a framework for building renovation. The legislative instruments, Law No. 372/2005 and Law No. 121/2014 transpose the EED and EPBD. The NECP sets national emission reduction goals, aligning with the EU-wide climate and energy targets for 2030. The LTRS contributes to energy saving targets by 30% reduction in final energy consumption.

The Romanian NECP, a key component of the country's energy legislation, is undergoing an update, as required every five years by EU regulations. Romania has yet to submit its revised plan, which is expected by June 30, 2024. This update is crucial as it aims to address existing shortcomings and align with the accelerated goals of the European Green Deal, particularly in promoting an efficient and decarbonised building stock by 2050.

The NRRP is a comprehensive strategy for national recovery, focusing on reforms and investments. Its main component, Component 5 – Renovation Wave, aims to increase renovations for public buildings, enhancing energy efficiency and reducing dependence on fossil fuels. Romania's NRRP has the second highest share of energy-related investments, after sustainable mobility. It provides financing for deep and medium renovations and energy-efficient building construction.

The LTRS aims to lead energy renovation efforts for public buildings, aiming to renovate 26% of the stock by 2030, achieve energy savings of 0.05 Mtoe and reduce CO_2 emissions by 0.25 Mtoe. Two programmes are proposed: a national programme for state-owned buildings and a similar programme for municipality-owned buildings. The proposed cost-optimal renovation packages aim to achieve nZEB requirements, improved lighting, and renewable energy installations. The LTRS outlines targets and milestones for 2030, 2040, and 2050.

The Romanian 2020 LTRS is undergoing slow implementation, with many measures such as approval of energy performance calculation methodology and the development of the building stock database. The Commission's latest NECP assessment highlights the need to enhance renovation targets, aiming for a 3-4% renovation rate for national energy efficiency and decarbonisation goals. The renovation of administrative buildings is supported through the NRRP.

The LTRS recommends renovation packages for various building types, including single-family houses, multi-family buildings, social housing, educational and health establishments, and office and commercial buildings. For single-family houses, a minimum renovation package (P1) is recommended, achieving an EPC rating of class C. Multi-family buildings should undergo average renovation packages (P2), incorporating renewable.

The LTRS aims to address seismic risk and promote energy efficiency in public buildings through mandatory requirements and a methodology for calculating energy performance. The project pipeline and development assistance system will ensure renovations of at least 26% of public buildings by 2030, 52% by 2040, and 100% by 2050. The Building Renovation Passport (BRP) will be included in the technical and procedural support for project documentation and funding access. Standard tender documentation is crucial for centralised procurement and energy efficiency renovation services.

The NECP's proposal suggests a regulatory framework for energy service companies (ESCOs) and an institutional framework for financial mechanisms, including a national or regional institution called

the Fund. This fund is responsible for mobilising funds, managing flows, and identifying financial needs. Financing schemes are offered for various building types, including government and commercial buildings. The proposal addresses spilt-incentive dilemmas in public building renovations.

The main financing programmes dedicated to energy efficiency renovations for public buildings are the Energy Efficiency in Public Buildings Programme, implemented by the Environmental Fund Administration (EFA), and the Regional Operational Programme (ROP) 2021-2027.

The Energy Efficiency in Public Buildings financing programme aims to improve public buildings' energy efficiency, reduce greenhouse gas emissions, and promote renewable energy sources. The programme includes renovation works like thermal wall insulation, upgrading equipment, and installing renewable energy systems. The funding is provided by ETS certificates, with a total sum of €120 million allocated in 2023. The Regional Operational Programme 2021-2027 (ROP) and the National Programme for the Consolidation of Buildings at Seismic Risk (NPCBSR) also offer funding for renovations. The Ministry of Energy also runs a Modernisation Fund program to support investments in renewable electricity generation capacity for self-consumption in the public sector.

The Ministry of Development, Public Works and Administration (MDPWA) is responsible for developing and managing a national building database, which includes information about building stock, typologies, construction periods, energy performance certificates, energy consumption, energy carriers, and seismic building characteristics.

Law No. 121/2014 of energy efficiency, transposing Directive 2012/27/EU, aims to increase energy efficiency at all stages of the energy chain, including primary resources, final consumption, production, distribution, supply, and transport. It provides organisational infrastructure, reporting standards, and a regulatory framework for energy audits and auditors. The EED directorate, under the Ministry of Energy, develops policy, monitors progress and certifies energy auditors and managers.

Law No.372/2005 regulates the national legislative framework for the energy performance of buildings and provides a general framework to reach the minimum energy performance required by nZEB obligations. However, the development and implementation of a calculation methodology, Mc-001-2022, have lagged. This new methodology requires more stringent energy performance values across eight classes, additional assessment of a building's environmental impact, and classifications based on pollution levels.

The State Inspectorate in Construction (SIC) is a public institution under MDPWA responsible for ensuring quality, compliance with urban planning standards, and professional conduct in the construction field. Since 2013, the institution has expanded to verify the energy performance of buildings and inspect heating and cooling systems.

3.4.2. Assessment of energy performance of related buildings

Romania faces challenges in meeting ambitious EU energy renovation targets due to the current pace and in-depth renovations. A study by EPG (2024) suggests that Romania needs to increase the depth of renovations to meet revised EU objectives, requiring 1.5 million m^2 of medium-high renovations and 1 million m^2 of deep renovations. However, financing programs for renovations focus on single-use renovations.

Romania's efforts to enhance building energy performance face obstacles such as discrepancies in policy, financing, and governance, as well as a lack of accurate building stock data. These concerns, combined with the difficulty in matching national intentions to real progress and adhering to EU directives, impede the refurbishment sector's capacity to reach energy-saving and GHG reduction targets. While EPCs are essential for tracking progress, Romania's absence of a comprehensive EPC database exacerbates efforts, particularly in public buildings where energy efficiency is critical.

A study by the MDPWA (2021) on obtaining nZEB certification in energy efficiency renovations in Romania concluded that the actual results did not always correspond to the energy performance calculations.

The Romanian LTRS proposes three cost-optimal renovation packages for four types of buildings. The P2 and P3 packages are considered deep renovations, leading to over 60% reduction in energy consumption. The observed energy performance gap may be partly due to methodological challenges in establishing and assessing energy efficiency performance. The lack of a framework for assessing, calculating, and verifying energy performance has impacted the design and execution of renovation projects, creating inconsistencies in energy performance outcomes and ensuring accurate evaluation of energy savings in practice.

The current methodology for the calculation of energy performance in buildings foresees significantly higher levels than the previous methodology, with healthcare facilities experiencing a 10% increase in upper limit values. However, energy classes provide some indication of a building's energy consumption for heating, cooling, ventilation, and lighting, but they have shortcomings in accurately predicting actual consumption during the building's operational stage. The rating scale relies on general assumptions about building types, independent of actual energy usage, leading to predicted energy consumption values often differing from actual consumption values post-renovation.

Occupants' behaviour and building energy performance are closely linked, with factors such as psychological, physiological, social, and cultural norms influencing energy consumption patterns in both residential and public buildings. In Romania, occupants prefer natural ventilation and use windows and doors to regulate indoor temperatures, resulting in increased energy use for heating and cooling when outdoor temperatures are extreme. Romanians living in urban areas prefer an indoor temperature of at least 22 degrees Celsius during winter, which is comparable to Poland's indoor temperatures.

3.5. Insights from across the region

Aside from the countries covered in this project, other CEE states face similar issues in overcoming underperforming renovations. For example, **Austria** faces a slow pace of rolling out deep renovations in its building stock, with only 0.2% per year of public building renovations being deep renovations and has seen a decline in the rate of medium and deep renovations over the past few years (European Commission, 2019). In addition to high costs, one of the main obstacles to scaling up restoration is the dearth of trained personnel in the energy and construction sectors. The lack of connections between public money for thermal restoration and renewable heating systems under the NRRP represents a missed chance to increase energy efficiency. Generally, Austria's NRRP includes provisions to support building renovation but falls short of the government's lofty renovation targets. The plan calls for a €17.5 million investment in commercial and municipal buildings and lists

two projects, totalling €13.9 million, to demonstrate the holistic repair of historic buildings. Austria's LTRS (European Commission, 2020) estimates that maintaining the country's overall current 1.5% renovation rate requires an annual investment of €5.3 billion, increasing to more than €10 billion with a 3% renovation rate. It is therefore crucial to evaluate the performance of renovations to ensure efficient spending of public funding.

In **Hungary** (BPIE, 2024), a diverse range of buildings leads to difficulties when it comes to collecting and interpreting data on building performance, which impacts renovation planning and implementation. With a slightly increasing, but still low, renovation rate (European Commission, 2020), Hungary would benefit from the development of tools and procedures for data collection and monitoring of building performance, allowing for better estimates of renovation needs. Hungary's final NRRP request for €7.2 billion in grants includes building renovation elements across various components, including energy, education, workforce competitiveness, public health, demography, and the Emerging Settlements programme. Infrastructural development plans cover university buildings, vocational institutions, and daycare nurseries, indicating an opportunity to implement recommendations for high-performance renovations in public buildings. This should be reflected in Hungary's NECP, which prioritises the decarbonisation of energy production and energy security, with less emphasis on and articulation of energy efficiency goals.

4. Possible causes of underperforming renovations in CEE countries

This chapter brings together the possible reasons for the prevalence of underperforming renovations identified in the OUR-CEE national baseline assessments and outlined in Chapter III of this report.

As indicated earlier, the four CEE countries covered in this project face a range of issues regarding the performance of renovations conducted on public buildings. Inadequate legislative frameworks, financial constraints, and the quality of implementation of renovation measures all contribute to the discrepancy between expected and actual energy performance. These challenges surface variously in the design, execution, and operating phases of the renovation process. Understanding these challenges can help improve renovation processes and reduce the risk of underperforming renovations locking CEE countries into expensive refurbishments with low impact on energy consumption.

The possible reasons leading to these underperforming renovations, on which data is scarce, are summarised in **Table 2**. They are grouped by renovation stage: planning and design (before commencement of the actual renovation works), execution, and operational (after finalisation of the renovation works and re-commencement of normal operations of the building).

Table 2: Possible shortcomings leading to underperforming renovations for CEE countries

These are detailed in the national baseline assessments of the OUR-CEE project.

Country	Stage	Possible shortcomings leading to underperforming renovations
Bulgaria	Planning and design	**Regulatory Framework**: For years, Bulgaria's regulatory framework set minimal energy performance requirements for renovations, often allowing only up to energy class C. This lack of ambition delayed more rigorous energy efficiency improvements. **Financial Incentives**: EU-funded programs offered high grant rates with minimal energy efficiency criteria, leading to superficial renovations that did not significantly enhance energy performance. **Municipal Planning**: Many municipalities approach energy efficiency planning superficially, often missing long-term goals and financial frameworks necessary for comprehensive energy upgrades.
	Execution	**Quality of Work**: Poor quality of construction is frequent due to inadequate energy audits and master project documentation, coupled with a tender process that prioritises lowest price over quality. **Contractor Selection**: The "lowest price" criterion in tender procedures often results in the hiring of less skilled workers and use of lower-quality materials, impacting overall renovation quality. **Oversight**: Insufficient quality control and oversight, particularly in smaller municipalities, exacerbate these issues, leading to subpar execution of renovation projects.
	Operational	**Monitoring and Verification**: There is a lack of mandatory monitoring and verification of energy savings post-renovation. This focus on meeting bureaucratic requirements rather than actual energy performance leads to underperforming renovations.
Croatia	Planning and design	**Regulatory Loopholes**: Croatia's regulations allow exceptions to energy performance standards, which are often used without sufficient justification, preventing buildings from achieving their full energy-saving potential. **Financial Constraints**: Limited budgets often force project designers to opt for partial renovations rather than comprehensive upgrades, which restricts the potential for significant energy savings. **Data Accuracy**: Inadequate data on existing building conditions and incorrect assumptions about energy consumption can result in discrepancies between projected and actual energy savings.
	Execution	**Documentation Quality**: Poor-quality energy audits and master project documentation, particularly for family houses, can lead to incomplete or ineffective renovation measures. **Contractor Selection**: Similar to Bulgaria, tendering based on the

Country	Stage	Possible shortcomings leading to underperforming renovations
		lowest price often results in poor-quality renovations due to the use of less skilled workers and cheaper materials. **Skilled Labor**: The lack of skilled labor, especially among foreign workers unfamiliar with local standards, impacts the quality of renovations. **Accountability**: There is often no clear responsibility assigned for underperformance in energy savings, which complicates the resolution of issues when renovations do not meet expectations.
	Operational	**User Education**: Post-renovation user behaviour, often due to lack of education on new systems, often leads to higher than expected energy consumption. **Verification**: Inadequate monitoring and verification of actual energy performance post-renovation mean that energy savings are not accurately assessed or realised.
Poland	**Planning and Design**	**Energy Modelling**: Inadequate energy modelling and audits before renovation often lead to inaccurate assessments of energy savings potential. This can result in renovations that fail to meet efficiency targets. **Project Authorisation**: Projects are sometimes approved without rigorous verification of compliance with energy efficiency standards, often due to time constraints or lack of detailed review
	Execution	**Construction Quality**: Poor-quality renovations can occur due to inexperienced construction teams, cost-saving measures, and non-compliance with standards. Lack of proper supervision exacerbates these issues. **Material and System Choices**: Decisions to cut costs can lead to the use of substandard materials and systems, which affect the final energy efficiency of the building.
	Operational	**User Awareness**: Building users may not be aware of how their behaviour impacts energy consumption, leading to inefficiencies that were not anticipated during the design phase. **Monitoring Systems**: The absence of energy consumption monitoring systems makes it difficult to identify and correct inefficiencies, further affecting overall energy performance.
	Planning and Design	**Regulatory and Financial Constraints**: Regulations focused on asset rating rather than actual performance, combined with incomplete analyses and budget constraints due to seismic requirements, often lead to inadequate renovation solutions. **Technical Interventions**: Projects frequently address isolated technical issues instead of integrating comprehensive solutions, resulting in suboptimal energy efficiency. **Policy and Implementation Gaps**: Misalignment between policy goals and local project execution, along with delays in tenders due

Country	Stage	Possible shortcomings leading to underperforming renovations
Romania		to the focus on lowest prices, hampers effective renovation outcomes.
	Execution	**Quality and Compliance**: Non-compliance with technical standards, use of substandard materials, and lack of oversight during renovation works contribute to lower quality results. **Skilled Labor**: There is a shortage of skilled workers which affects the overall quality of the execution of renovation projects.
	Operational	**User Behaviour and Monitoring**: Increased energy consumption often results from inadequate user education and lack of systematic monitoring of energy efficiency post-renovation. The absence of continuous performance tracking makes it difficult to ensure the effectiveness of renovations.

As indicated in the above table, underperforming renovations in Bulgaria, Croatia, Poland, and Romania are the result of a complex interaction of legislative, financial, and execution problems. In many of these countries, inadequate energy performance of renovated public buildings is frequently caused by a lack of appropriate ambition and guidelines.

Often, this lack of ambition is coupled with a lack of knowledge of the actual situation regarding underperforming renovations, potentially increasing the gap between targets and reality in terms of building energy performance. A lack of post-renovation monitoring by owners of public buildings compromises the visibility of renovation performance and opportunities to tighten guidelines, increase ambition, and consider different contracting criteria to enhance the impact of renovations. This issue is exacerbated by the limited financial and institutional capacity of public authorities to plan high-performing renovation works based on monitoring of those already conducted.

Issues during the execution stage of a renovation project may also contribute to underperforming renovations. Poor-quality energy audits and renovation works, driven sometimes by the practice of awarding tenders based on lowest-price criteria, all have a negative impact on renovation outcomes. Behind the cases of low quality, there is usually a lack of skills and knowledge of the stakeholders executing the renovation, such as energy auditors, building contractors, and specialist installers. These skills gaps will have an increasing impact on the ability of CEE countries to overcome their issues of underperforming renovations and may jeopardise opportunities for public buildings to champion high-quality renovations and create positive spillover effects to other buildings in need of renovation.

Operationally, user behaviour (for example, a potential rebound effect) also contributes significantly to the gap between predicted and actual energy savings. To this end, the education and awareness of building users is key to ensure that new systems are being used efficiently, and lower energy costs (for example, due to a reduction in heat losses) do not spur over-use of heating, electrical, and ventilation systems. Renovation works should take into account the subtleties of a building's purpose and use patterns, for example in deciding where energy-saving lighting systems are appropriate given the need for certain lighting quality, or where timer-based heating systems may be introduced without disrupting users' activities.

A standout challenge across all countries is the absence of post-renovation monitoring, and as a result an unavailability of data on actual building performance improvements across heating seasons, after renovation. This makes it difficult to estimate the magnitude of the performance gap, particularly in countries such as Poland and Romania, where as indicated in the previous section post-renovation building performance data at the national level is extremely limited. Unless knowledge of the magnitude of this issue is improved, implementing policy recommendations to tackle the above barriers will likely be poorly targeted and inefficient.

After identifying the reasons for underperforming renovations in CEE countries, the following chapter will focus on the common challenges shared across the region. While each country faces its own specific issues, broader challenges affect the entire region and require collective attention.

5. Common challenges

With a clear understanding of the regional insights, it is essential to delve into the common challenges that persist across CEE, to highlight shared obstacles and systemic issues that affect energy efficiency and renovation efforts throughout the region. Understanding these common challenges is crucial for developing effective, targeted strategies to improve building performance and sustainability.

The four CEE countries covered in this project share common goals in their long-term renovation strategies, focusing on improving the energy efficiency of their building stock by 2050. All countries aim to reduce energy consumption, combat energy poverty and decarbonise their buildings, in alignment with the EU targets. However, they all face significant challenges, including capacity constraints, outdated construction practices that may not be compatible with modern renovation techniques, and an older, inefficient building stock. The success of renovation will depend on overcoming these obstacles and ensuring that renovation efforts are both comprehensive and sustainable, leading to the achievement of planned energy savings while addressing specific national challenges in building planning, design, execution, and operation.

One of the common challenges in achieving energy-efficient building renovations in CEE states is **the lack of comprehensive and accessible data**. In Romania and Poland in particular, there is a significant gap in the availability of up-to-date databases on building stock and energy performance. This data deficit makes it more difficult for policymakers and other stakeholders to plan and implement effective renovation strategies. On the other hand, while Bulgaria and Croatia have made more progress in collecting and managing building data, there are still gaps that obstruct a full understanding of renovation needs and progress. There is a need for more detailed and reliable data so that priority areas for intervention can be identified and remedial action can be measured more accurately.

Proper **monitoring and evaluation mechanisms** are essential to assess the efficacy of renovation projects and implement the necessary adjustments. However, the four CEE countries have deficient effective methods for monitoring and evaluating energy efficiency progress. Without these methods, it is difficult to track progress, identify successful strategies and instruments, and address underperforming restorations. Implementing extensive monitoring and evaluation systems is essential for ensuring that building renovation activities get the expected results.

Lack of institutional capacity. The resource constraints of local authorities pose challenges for creating and implementing ambitious policies for high-performing renovations. However, it also

poses challenges on a practical level, as public institutions are the owners of public buildings and are responsible for managing renovations on these buildings. Institutional knowledge in managing and implementing extensive energy improvements on these types of buildings is frequently missing. This lack of awareness and competence leads to poor underperforming renovation plans and wasted opportunities for energy optimisation. The **lack of awareness and knowledge** among public building owners about behavioural factors affecting energy performance, as well as about the need to monitor energy performance post-renovation and avoid the risk of a rebound effect, can pose further challenges.

Inconsistent guidelines and regulatory frameworks exacerbate the challenges of energy-efficiency renovations in CEE countries. Although all four countries have transposed EU directives and adopted long-term renovation strategies, the policies vary considerably. Poland and Croatia developed more advanced legislation to improve energy efficiency, but there is a lack of enforcement and specific mandates for renewable energy integration. Romania and Bulgaria need additional policy support to properly implement energy efficiency measures. Furthermore, existing policies and incentives frequently fail to inspire property owners to invest in cost-effective energy improvements/energy-saving improvements.

Financial barriers are a common challenge across CEE countries, particularly when it comes to deep renovations. According to BPIE (2017), financial hurdles are one of the main obstacles to deep renovation in CEE countries. Low energy prices, expectations for significant state subsidies, and payback expectations, along with a lack of knowledge and/or professional advice regarding the benefits, appropriate solutions, and funding availability, make deep renovation appear unappealing due to the need for skilled specialists, extensive planning, and post-renovation monitoring, further adding to the overall cost.

A **lack of skills and competencies** of renovation stakeholders may pose a further challenge to overcoming underperforming renovations. Executing high-performing renovations and post-renovation monitoring on an ageing building stock requires specialised expertise, and ensuring the availability of qualified professionals and innovative technical solutions is vital to overcome these impediments. Additional complexities, such as the need for renovation to reduce the seismic vulnerability of buildings in Romania, may increase the number and range of skills required to undertake high-performing renovations in certain countries.

Efforts focused on improving building energy efficiency are frequently **fragmented and lack coordination among multiple stakeholders**, including public institutions, renovation contractors, and energy auditors. This dispersion usually leads to inefficiencies and wasted opportunities for cooperation, as well as a lack of visibility by public authorities of the post-renovation building performance. Encouraging coordination and collaboration among all relevant parties is critical for maximising the success rate of the renovation activities and exploiting the pooled expertise and resources.

The challenges of overcoming underperforming restorations in Romania, Bulgaria, Poland, and Croatia (as well as other CEE countries) are complex and interconnected. To address these challenges, a comprehensive approach is required, which includes improving data collection and accessibility, providing financial support and subventions, strengthening policy frameworks and guidelines, addressing technical barriers, increasing awareness and knowledge, implementing solid monitoring and evaluation mechanisms, and increasing stakeholder coordination and

collaboration. The following section presents a series of policy recommendations to overcome underperforming renovations in CEE.

6. Conclusions and recommendations

6.1. Conclusions

To achieve the EU's ambitious energy efficiency goals, annual energy renovation must increase, and renovations must deliver energy savings as planned. In the CEE region, an old and energy-inefficient building stock, often built with inadequate insulation and lacking sufficient maintenance, has led to continued and distinct energy efficiency challenges. These challenges stem largely from the age and design of the buildings, along with a heavy reliance on fossil fuels. Although there are encouraging signs of reduced energy use and emissions, the region's progress lags that of other parts of Europe. Decarbonisation efforts in the area show mixed results, largely driven by EU policies and financial support. In addition, the institutional capacity to deliver high-performing renovations depends largely on the decisions taken by governments, which influence the pace and effectiveness of these efforts.

The challenges of overcoming underperforming restorations in Romania, Bulgaria, Poland, Croatia, and other CEE nations are complex and interlinked. Addressing them necessitates a diverse approach, involving multiple stakeholders. This approach must start with an increased ambition for building renovation in national policy, followed closely by adequate regulatory frameworks and overcoming enforcement challenges. For example, Poland and Croatia have established advanced legislation frameworks for building renovation, but face challenges with enforcement and the integration of renewable energy sources. On the other hand, Romania and Bulgaria require additional support to effectively address energy efficiency measures and, in the case of Romania, seismic risks.

Possibly the greatest challenge in tackling underperforming renovations is the lack of accessible and accurate data on the scale of the performance gap itself. This is strongly linked to low levels of digitalisation within public institutions, as well as a lack of capacity and unclear responsibilities for monitoring the performance of renovations – which in the case of public buildings are publicly funded. These issues are prevalent in the OUR-CEE project countries and are compounded by a lack of resourcing of public institutions, which often lack the skill and competencies to plan and monitor complex deep renovation projects.

The need for increased support, capacity building, and funding is a common thread running through the area, emphasising the need to address these challenges to meet the EU's energy efficiency targets. A lack of financial support, such as grants, low-interest loans, and tax breaks makes deep renovation challenging in general, and the lack of public institution resourcing only compounds it. Moreover, a lack of skills and competencies among companies executing renovation projects, which often require specialised knowledge and creative solutions to fulfil modern energy efficiency criteria, means that qualified professionals and creative solutions are critical for reducing the risk of underperformance in the execution stage of a renovation.

The successful implementation of energy-efficient renovations is hindered by a lack of awareness and knowledge among building owners and the general population about the long-term economic and environmental benefits of energy efficiency, and the need to continuously monitor energy performance to avoid behaviour-driven rebound effects. The absence of expertise frequently results

in ineffective renovation plans and wasted opportunities for energy efficiency. Romania, with its distinct environment and geographical coordinates, is particularly vulnerable to seismic activity, complicating already difficult renovation projects.

6.2. Recommendations

The distinct challenges of the CEE region, as well as of underperforming renovations, mean that a new approach to renovation may be required, focusing on the monitoring of renovation performance, the design of policies to avoid the risk of underperforming renovations, and building competencies and skills among stakeholders in the public sector. A brief list of general recommendations is summarised below, with country-specific policy recommendations listed in the next and final section of this report.

- **Monitor and evaluate renovation outcomes** by conducting regular assessments through performing ongoing evaluations of renovation projects to measure their effectiveness identify areas for improvement and adjust the strategies based on the obtained results. This includes establishing defined criteria, generating standardised measurements, and ensuring uniform data gathering across all CEE countries to allow for reliable progress tracking and measuring the success of reconstruction activities.
- **Improve availability and accessibility of data.** Investing in modern data collection systems and increasing the availability of energy performance data. Enhanced data will be helpful in better decision-making and developing policies by providing a clearer picture of progress and areas that require improvement.
- **Increase knowledge, capacity and skills to plan, execute, and monitor renovation projects amongst relevant renovation stakeholders, particularly given the limited resources of public authorities owning public buildings and designing renovation policies and programmes.** Enhance technical training and invest in upskilling professionals to ensure they have the expertise needed for advanced energy renovation techniques.
- **Strengthen policy frameworks and incentives** by revising and enforcing energy efficiency regulations to ensure they meet EU standards and address the specific needs of the region and introduce financial incentives which will provide targeted grants, low-interest loans, and tax breaks to encourage private investment in energy-efficient renovations.
- **Address financial barriers and improve financing models**: by developing innovative financing solutions, such as energy performance contracting or public-private partnerships, to reduce upfront costs for property owners.
- **Improve project management and implementation** by adopting renovation best practices from other regions or countries with similar challenges.
- **Increase stakeholder coordination** Improve collaboration between renovation stakeholders, for example by establishing integrated platforms or panels devoted to energy efficiency, which can assist streamline efforts and eliminate inefficiencies created.
- **Promote regional partnerships** by focusing on common challenges and opportunities. Building stronger connections and exchanging successful ideas, CEE countries may mutually enhance their capability to adopt efficient energy saving measures and accomplish common sustainability goals.

- **Increase public awareness and engagement**: by launching campaigns to raise awareness about the benefits of energy-efficient renovations amongst public building users, and involve local communities and stakeholders in renovation projects to build support and drive participation.
- **Focus on energy performance standards for new buildings** by implementing stricter standards: Ensure that new buildings adhere to high energy performance standards, setting a benchmark for future renovations and improvements.

6.3. Country-specific policy recommendations

Managing the challenge of underperforming renovations in public buildings involves a diverse approach that corresponds to each country's specific context. Policy interventions are required to remove obstacles and guarantee that building renovations in Bulgaria, Croatia, Poland, and Romania achieve their energy efficiency and decarbonisation goals. Each country confronts a range of challenges, with commonalities across them, ranging from improving design and execution procedures to strengthening capacity-building and financing methods.

The following section presents a series of policy recommendations for the four countries analysed in this project. Many are applicable across countries, and to other CEE countries not covered in this report. A more detailed view of these recommendations can be found in the country-specific reports of the OUR-CEE project.

6.3.1. Policy recommendations for Bulgaria

PLANNING AND DESIGN STAGE

- **Strengthen Implementation of LTRS Measures:**
    - Conduct a thorough evaluation of the LTRS measures, analysing both successful and unsuccessful implementations. Prioritise and refine effective measures to ensure practical application and overcome theoretical limitations.
- **Incorporate Step-by-Step Renovation:**
    - Introduce and mandate the step-by-step renovation approach, ensuring that each phase of renovation applies the most advanced technologies and energy-efficient measures. This approach should be standard practice to progressively meet long-term renovation goals.
- **Make Building Renovation Roadmaps (BRRs) Mandatory:**
    - Enforce the mandatory use of Building Renovation Roadmaps (BRRs) alongside the new energy performance certificates. BRRs should provide detailed, long-term renovation strategies with specific energy-saving measures and financing guidance.

EXECUTION STAGE

- **Revise Energy Consulting Services:**
    - Overhaul energy consulting services to provide comprehensive and integrated advice. Ensure that services include post-renovation education and training for building owners to maintain and enhance energy savings.

- **Enhance Training for Key Stakeholders:**
    - Develop and implement specialised training programs for energy auditors, designers, construction firms, financial institutions, municipal authorities, and property owners. Utilise regional and municipal one-stop shops (OSSs) for widespread training on new renovation approaches and technologies.
- **Establish Quality Assurance Measures:**
    - Implement stringent quality control measures and responsibility clauses in renovation contracts to ensure high standards of workmanship and compliance with energy performance expectations. Avoid solely relying on the "lowest price" in contractor selection.

OPERATIONAL STAGE

- **Establish the National Decarbonisation Fund:**
    - Launch the National Decarbonisation Fund, as outlined in the LTRS and Recovery and Resilience Plan (RRP). The fund should offer diverse financial instruments to support deep renovations and encourage private investment through Energy Service Companies (ESCOs).
- **Introduce New Financial Mechanisms:**
    - Develop new financial tools to attract private funding for building renovations. These mechanisms should enhance the scale and effectiveness of renovation projects across Bulgaria.
- **Update Municipal Energy Plans:**
    - Ensure municipal energy plans align with the National Building Renovation Work Plan (NBRP). These plans should include detailed roadmaps for achieving climate neutrality and energy efficiency for municipal buildings by 2050.
- **Develop a Municipal Energy Management Platform:**
    - Create a municipal energy management platform for tracking, analyzing, and reporting energy consumption data. This platform should facilitate reporting to SEDA and support energy management at the municipal level.
- **Mandatory Monitoring and Verification:**
    - Implement mandatory monitoring and verification of energy savings, renewable energy consumption, and CO2 emissions for all funded projects. Provide incentives for continuous monitoring and control in buildings to ensure long-term performance and compliance.

6.3.2. Policy recommendations for Croatia

DESIGN AND PLANNING STAGE:

- **Improve Design Process:**

  - **Conduct Needs Analysis:** Perform comprehensive analyses of building users' needs to ensure that energy renovations align with real, measured energy savings and performance expectations.
  - **Establish High Standards:** Develop and enforce guidelines to achieve high standards such as nZEB during the design phase, ensuring the final renovation meets advanced energy efficiency criteria.

- **Enhance Project Management:**
  - **Experience and Training:** Ensure project managers and involved stakeholders possess relevant experience and continuously update their knowledge through ongoing education and certification. This is crucial to adapt to evolving EU directives and maintain project alignment with the latest standards.

- **Implement Quality Assurance Measures:**
  - **Strict Quality Control:** Introduce stringent quality control protocols to guarantee high standards of workmanship throughout the renovation process. Establish responsibility clauses for situations where anticipated energy savings are not achieved.
  - **Selection Criteria:** Avoid using "lowest price" as the primary criterion in contractor selection; instead, prioritise quality and capability to ensure effective renovation outcomes.

- **Develop Maintenance and Evaluation Strategies:**
  - **Comprehensive Maintenance Plans:** Create and enforce detailed maintenance plans to extend the lifespan and efficiency of renovations.
  - **Ongoing Monitoring:** Implement robust systems for the continuous monitoring and evaluation of renovated buildings to ensure they meet performance expectations and adapt as necessary.

EXECUTION STAGE:

- **Dedicated Funding and Budget Management:**
  - **Secure Funding:** Ensure adequate funding is allocated for energy renovation projects, including provisions for covering unexpected costs that may arise during the renovation process.
  - **Financial Incentives:** Provide financial incentives for projects that meet or exceed sustainability criteria, promoting higher standards of energy efficiency and environmental impact.

- **Stakeholder Engagement:**
  - **Inclusive Planning:** Involve building users and community members in the renovation planning process to ensure that renovations address their needs and preferences.

- **Enhance Communication:** Foster improved communication and coordination among all stakeholders involved in the energy renovation process to facilitate better project outcomes.

- **Promote Sustainability and Energy Efficiency:**
  - **Use of Sustainable Materials:** Encourage the use of sustainable materials and energy-efficient technologies in all public building renovations.
  - **Incentives for Sustainability:** Offer financial incentives to projects that meet or surpass established sustainability and energy efficiency benchmarks.

OPERATIONAL STAGE:

- **Technological Integration:**
  - **Modern Technologies:** Promote the integration of advanced technologies to enhance building functionality and adaptability. Ensure that contractors and designers are well-versed in these technologies through ongoing education and training.
- **Economic and Political Stability:**
  - **Stable Funding Sources:** Secure stable funding mechanisms to ensure the continuity of renovation projects regardless of economic or political fluctuations.
  - **Consistent Policy Support:** Maintain consistent policy support for public building renovations across different government administrations to ensure project stability and progress.
- **Long-term Renovation Planning:**
  - **Introduce Building Renovation Roadmaps (BRPs):** Develop and implement BRPs as a strategic tool for stepwise building renovation, aiming for sector-wide decarbonisation by 2050. These roadmaps should provide detailed measures and strategies for achieving long-term renovation goals.

6.3.3. Policy recommendations for Poland

DESIGN AND PLANNING STAGE:

- **Introduce Unified and Ambitious Guidelines:**
  - **Develop Standardised Guidelines:** Establish comprehensive and ambitious guidelines for public building modernisation that define clear and measurable energy efficiency standards. These should include best practices for the design, implementation, and monitoring of renovation projects to ensure high performance and significant energy savings.
  - **Regular Updates:** Ensure that the guidelines are regularly updated to reflect the latest technological advancements and evolving climate goals, maintaining alignment with high energy efficiency standards.
- **Leverage Private Sector Resources:**

- **Explore Alternative Financing:** Investigate and promote alternative financing methods such as public-private partnerships and Energy Service Company (ESCO) models to fund thermal efficiency improvements. Collaborate with entities like the National Fund for Environmental Protection and Water Management (NFOŚiGW) and the Polish Development Fund (PFR) to facilitate these initiatives.
- **Promote Investment:** Use successful European examples to encourage the involvement of private sector resources in financing public building renovations, aiming to increase accessibility to necessary funds.

- **Implement a Data Management System:**
  - **Develop a Comprehensive System:** Create a structured data management system to track and analyse the energy efficiency and renovation needs of public buildings. Improve the current system to include detailed information on energy consumption and renovation requirements.
  - **Facilitate Aggregation:** Streamline the process of aggregating renovation projects to enable better access to funding and attract private investment by grouping similar projects into comprehensive investment packages.

EXECUTION STAGE:

- **Address Capacity Gaps in Public Administration:**
  - **Capacity Building:** Implement targeted training and capacity-building programs to enhance the expertise of public administration employees in managing and executing energy efficiency improvements. This is crucial for both conventional and historic buildings.
  - **Develop Expertise:** Focus on increasing the knowledge and skills of public sector employees to handle energy renovations effectively, addressing the general capacity gaps within public administration.
- **Implement Quality Assurance Measures:**
  - **Establish Quality Standards:** Introduce and enforce strict quality control measures to ensure high standards of workmanship and effective performance of renovation projects. Ensure that projects meet the established energy efficiency standards.

OPERATIONAL STAGE:

- **Introduction of the Energy Class System:**
  - **Develop and Implement an Energy Class System:** Collaborate between the Ministry of Development and Technology and the Ministry of Climate and Environment to prepare and implement a national energy class system. This system should be developed based on the final shape of the recast EPBD and feedback from national stakeholders.
  - **Financing and Implementation:** Utilise public administration funds to finance the energy class system, with a target for full implementation within three years. This

initiative will enhance building energy efficiency and support sustainable development goals.

6.3.4. Policy recommendations for Romania

DESIGN AND PLANNING STAGE:

- **Build Comprehensive Stock Data Management:**
  - **Develop a Detailed Database:** Create a comprehensive, up-to-date database of Romania's building stock. This should include detailed information on built areas, energy consumption, renovation measures, technical specifications, and energy performance certificates (EPCs). Ensure this data is publicly accessible to improve transparency and track progress towards energy efficiency goals.
  - **Enhance Renovation Programs:** Use this data to inform and improve renovation programs, ensuring they are based on a detailed understanding of the building stock and its needs. This will help translate policy measures into effective, cost-efficient solutions.
- **Implement Energy Management Systems (EMS):**
  - **Adopt EMS in Public Buildings:** Facilitate the adoption of Energy Management Systems (EMS) in public buildings to monitor and manage energy consumption. Provide financial incentives, training, and technical support to local authorities for successful implementation.
  - **Mandate Monitoring:** Make energy consumption monitoring mandatory for public buildings, integrating it into renovation planning and tendering processes to ensure ongoing evaluation and optimisation.
- **Enhance Capacity Building:**
  - **Increase Administrative Capacity:** Strengthen the administrative capacity at both central and local levels to efficiently process funds, approve financing requests, and oversee renovation projects. Ensure that administrative and technical staff are well-trained and equipped to manage and implement energy efficiency projects.
  - **Focus on Local Administrations:** Empower local administrations with the necessary resources, expertise, and financial support to lead energy efficiency renovations and ensure compliance with legal frameworks and financing requirements.

EXECUTION STAGE:

- **Strengthen Quality Assurance and Evaluation:**
  - **Implement Quality Control Measures:** Introduce and enforce strict quality control measures throughout the renovation process. Ensure thorough inspections and evaluations to verify that renovations meet energy performance targets.
  - **Improve Evaluation Methodologies:** Utilise advanced technologies and methodologies to assess the quality of renovation work, focusing on aspects such as air-tightness, insulation quality, and heating/cooling system performance.

- **Develop Integrated Financing Instruments:**
    - **Create a Unified Financial Framework:** Establish an integrated financial instrument to consolidate national and EU funds for energy efficiency and renovations. This should include consistent monitoring, performance indicators, and streamlined processes to reduce administrative burdens and improve access to funding.
    - **Leverage Private Capital:** Develop legislative and regulatory frameworks to attract private investment, such as ESCO (Energy Service Company) models, to supplement public funding and address the high costs of comprehensive renovations.

OPERATIONAL STAGE:

- **Enhance Awareness and Training:**
    - **Raise Awareness Among Occupants:** Develop programs to educate building occupants on how to use renovated buildings and their equipment effectively. Promote general awareness about energy-efficient practices and the benefits of reducing energy consumption.
    - **Foster Interdisciplinary Collaboration:** Support awareness campaigns and joint projects that bring together different professions involved in the construction and renovation process. Establish collaborative platforms and educational programs to drive innovation and improve overall efficiency.
- **Improve Post-Renovation Monitoring and Evaluation:**
    - **Mandate Post-Renovation Monitoring:** Require ongoing monitoring and evaluation of renovated buildings to ensure they meet energy savings targets. Address any performance issues that arise through continuous oversight and corrective actions.
    - **Strengthen Inspection Capacities:** Enhance the capacity for inspection and control activities to ensure that renovations achieve the desired energy performance. Address gaps in equipment, skills, and staffing for effective quality assessments.

These guidelines, focusing on key topics such as data administration, monitoring, quality assurance, and capacity building, provide a strong framework for overcoming current deficiencies in remodelling procedures. Implementing these policies would not only improve the performance of public building restorations but will also help to achieve overall energy efficiency and sustainability goals. Through persistent efforts and strategic investments, these countries can achieve substantial advancements in their building sectors, ultimately fostering a more energy-efficient and resilient future.

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